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Status of the Smooth Greensnake (*Opheodrys vernalis*) in North Carolina and Virginia

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ABSTRACT

Opheodrys vernalis occurs in high elevation open habitats in the southern Appalachians in West Virginia, Virginia, and formerly in North Carolina. I review the available literature, museum, and personal observation records of this colubrid snake in the southeastern portion of its wide and fragmented range in North America. Extant populations occur in portions of the Blue Ridge Mountains along the Blue Ridge Parkway and Skyline Drive in Shenandoah National Park in Virginia. Populations also exist atop high elevation ridges in the Ridge and Valley Physiographic Province in the George Washington and Jefferson National Forests and other locations. A recently discovered specimen in Floyd County, Virginia, suggests that populations remain extant south of the James River in the Blue Ridge Mountains. Three locations are verified for Bland and Giles counties south of the New River. All other known populations occur north of the New River. A population at Mountain Lake Biological Station, Giles County, has apparently become extirpated. An extant specimen from the mountains of North Carolina collected in 1871, observations by W.H. Weller in 1928-1930, and observations by R.L. Hoffman in 1952 represent the only known records of *O. vernalis* in North Carolina. This snake is apparently extinct in that state. *Opheodrys vernalis* populations may be declining due to lack of maintenance of high elevation grasslands and balds by natural or prescribed fire. Conservation of this species in the southern Appalachians requires management of all known locations through use of prescribed fire and maintenance of open grassy areas.

Key words: Blue Ridge Parkway, conservation, management, Mountain Lake Biological Station, National Forest, North Carolina, *Opheodrys vernalis*, Shenandoah National Park, Virginia.

INTRODUCTION

The Smooth Greensnake (*Opheodrys vernalis*) occurs throughout an extensive, albeit patchy, range across the northern half of the United States and into southern Canada (Conant & Collins, 1998). Its distribution extends from Nova Scotia south through the Virginia mountains and west to Manitoba and Utah, then south through the Rocky Mountains to northern Mexico (Walley, 2003). Most of the western and southwestern areas occupied by this snake are disjunct and isolated (e.g., the Midwest, southeastern Texas, New Mexico, and Chihuahua, Mexico). A Pleistocene fossil was recovered in northern Florida (Meylan, 1982); no records occur in the hiatus between this location and the southern Appalachians. The fragmentary distribution of this species, especially westward and southward, implies a withdrawal to the north during a more austral occurrence, presumably post-Pleistocene.

Expansion and contraction of ranges are a normal part of a species' evolutionary history and are presumably characteristic for most, if not all, organisms in eastern North America. Range contractions of the Timber Rattlesnake (*Crotalus horridus*) and the Eastern Diamond-backed Rattlesnake (*Crotalus adamanteus*) result from impacts of modern human activities on the landscape and on the snakes themselves (Brown, 1993; Martin & Means, 1999-2000; Timmerman & Martin, 2003). Changes in the distribution pattern of *Opheodrys vernalis* in the southern Appalachian Mountains provide another example of range contraction mediated to some extent by human activities.

The known distribution of *O. vernalis* in Virginia can be visualized from its treatment in Mitchell (1994) and Mitchell & Reay (1999). All of the available

capture and observation records are for the northern Blue Ridge Mountains, except for one (see below for discussion), and the Ridge and Valley Physiographic Province north of Bland County. All known localities in this portion of its range are above 1100 ft (340 m) elevation (Hoffman, 1986). Smooth Greensnakes occur throughout most of the highlands of West Virginia, including four counties bordering Virginia: Greenbrier, Pocahontas, Pendleton, and Hardy (Greene & Pauley, 1987). This is an example of a boreal species distribution pattern. My review of the putative contraction of this species' range in the southern Appalachians is based on observations provided by Richard L. Hoffman (pers. comm.), the Natural Heritage Division of the Virginia Department of Conservation and Recreation, museum records, personal observations of this snake, and my interest in its conservation status in this region. I provide a narrative review of the localities from historical collections and observation dates, and add recommendations for conservation and management of this colubrid snake.

OPHEODRYS VERNALIS IN VIRGINIA

Probably the first Virginia specimen of *O. vernalis* to be secured was taken at Mountain Lake, Giles County, by Paul R. Burch; the exact date is unknown but likely to have been after 1936 (Hoffman & Mitchell, 1994). Uhler et al. (1938) reported that five *O. vernalis* were collected by the Civilian Conservation Corps (CCC) in the George Washington National Forest between September 1936 and May 1937. The U.S. Biological Survey vertebrate collection that contained some of the CCC specimens was formerly housed at the Patuxent Wildlife Research Center, Maryland; it was transferred to the Smithsonian Institution in the 1990s. Unfortunately, none of the *O. vernalis* specimens from the CCC days remain extant. Only two of these records have locality information: North River Gap and Ramsey's Draft, both in Augusta County (based on species cards at Patuxent Wildlife Research Center, Laurel, Maryland; now in the Smithsonian Institution; examined by JCM in 1984). Dunn (1936) did not include this species in his unpublished mimeographed checklist of amphibians and reptiles of Virginia, nor did Wright & Wright (1952) in their checklist of snakes of the United States and Canada.

A specimen in the Smithsonian Institution (USNM 10800) labeled as *Cyclophis* (=*Opheodrys*) *vernalis* was collected on 21 May 1878 at Chula, Amelia County, Virginia. It was cited as a valid Virginia locality by Yarrow (1882), Cope (1900), Dunn (1918), and Linzey & Clifford (1981). The specimen cannot be found in the USNM collection (K. Tighe, pers. comm., 10 January 2007) and is presumed erroneous due to its collection locality being far outside the known range of this species (Mitchell, 1994).

During the 1940s, Richard L. Hoffman encountered *O. vernalis* several times a year up to 1950 around Clifton Forge, Alleghany County (Hoffman, 1945, 1986). That only three found their way into scientific collections (USNM 127598-99, 133049) simply reflected his reluctance to kill and preserve vertebrates (R. L. Hoffman, Virginia Museum of Natural History, pers. comm.). Hoffman (1986) noted that the Rough Greensnake (*O. aestivus*) and *O. vernalis* occurred sympatrically around Clifton Forge in the 1940s. Hoffman (pers. comm.) found one on Co. Rt. 758 in the summer of 1962 at the Roanoke-Montgomery county line 16 km southwest of Catawba. No other *O. vernalis* were seen by Hoffman in the area for another 13 years, when in 1975 he found a gravid female on Jack Mountain southeast of Monterey in Highland County (R. L. Hoffman, pers. comm.). The individual was photographed and released and the resultant Kodachrome slide deposited in the Virginia Herpetological Society photographic collection. Since 1962, R. L. Hoffman (pers. comm.) has driven conservatively a half-million miles on western Virginia roads and expended thousands of field hours without seeing another Smooth Greensnake, alive or as a road-kill.

In 1951, Walter Newman and R. L. Hoffman found a road-killed *O. vernalis* on Va. Rt. 311 west of Newcastle, Craig County (USNM 144115). Linzey (1959) found *O. vernalis* on the Blue Ridge Parkway at Clarks Gap in Rockbridge County and near Iron Mine Hollow, on the Blue Ridge Parkway in Botetourt County, both in 1957 (apparently housed in his private collection). W. H. Martin (pers. comm.) observed a DOR specimen on 8 August 1969 at the south entrance of the Bluff Mountain tunnel on the Blue Ridge Parkway in Amherst County.

Douglas Robinson collected a male *O. vernalis* 52 m S of the north entrance of Shenandoah National Park on 27 June 1953 (American Museum of Natural History, AMNH 75820). Witt (1958, 1963) reported on Smooth Greensnakes that he and others collected from Buffalo Gap in Amherst County on 2 September 1956 (USNM 138740), Jarman Gap Shenandoah National Park (SNP) in Augusta County on 24 May 1951 (USNM 146633), and Page County near Big Meadows in SNP on 6 October 1960 (USNM 145929). Witt also collected a road kill on Skyline Drive in SNP opposite Tanner's Ridge Overlook on 16 July 1957 (USNM 139393). Another specimen collected on 12 April 1975

at Big Meadows (SNP) was in the former VPI&SU collection but is now in the AMNH (129608). Additional specimens from SNP include Carnegie Museum of Natural History (CMNH) 53580 at Milepost 69, and observations by W. H. Martin (pers. comm.) from Pinefield Gap on 13 May 1974, MP 95.7 on 18 September 1976, and Loft Mountain Picnic ground on 29 April 1975. W.H. Martin (pers. comm.) found eleven snakes at Big Meadows and other locations on Skyline Drive in the Central and Southern districts of Shenandoah National Park between 1967 and 1975.

Two other specimens in the Smithsonian Institution provide records for Catawba, Roanoke County (27 May 1962; USNM 149120), and on the Skyline Drive at South Bluff Mountain, Amherst County (8 August 1969; USNM 167179). S. Blair Hedges collected a specimen southeast of Healing Springs in Bath County on 25 September 1976 (USNM 219051). Mercedes Foster added another *O. vernalis* to the Smithsonian collection from the George Washington National Forest on Forest Service Road 85 near the Virginia-West Virginia state line in Rockingham County (21 July 1990, USNM 304289).

Gary W. Woodyard (formerly with the Virginia Department of Game and Inland Fisheries, in correspondence to F. J. Tobey on 14 November 1974) noted that he had observed several Smooth Greensnakes (as well as *O. aestivus*) at Buckhorn Draft in Gathright Wildlife Management Area, Bath County, in 1967; on Coles Mountain, also in Bath County, in 1974; around Pearisburg, Giles County, in the early 1960s; and in Bland County 3.6 km SW of the Giles County line near Walker's Creek in the 1960s. All of these locations were plotted on the *O. ventralis* map in Tobey (1985). Tobey also plotted a location 6.4 km N Bristol on Walker Mountain, Washington County, provided by an unknown source. This was apparently based on a putative specimen in the University of Tennessee, Knoxville, herpetological collection. However, I could not locate it when I searched the collection in 1976, nor did its curator know about such a specimen (A. C. Echternacht, pers. comm.).

John Pagels and the Virginia Commonwealth University Mammalogy class collected a specimen from Paddys Knob in Bath County on 4 September 1974 (North Carolina Museum of Natural Sciences NCSM 68688). A specimen collected by S. B. Hedges from Douthat State Park, Bath County, in 1979 was in the George Mason University Vertebrate Collection (GMU 84) but the collection is now in the Smithsonian Institution (uncatalogued). Twelve specimens were collected near the summit of Bald Knob on Warm Springs Mountain, Bath County, by J. C. Mitchell and C. A. Pague on 23 August 1984 (USNM 516623-516634). Most of these specimens were neonates from a clutch of eggs found on that date. A specimen from Red Oak Knob near the West Virginia line in Highland County was collected by J. Pagels on 9 October 1987 (NCSM 68686). Richard L. Hoffman (pers. comm.) captured a gravid female near Monterey, Highland County, in 1975 and D. A. Young (1993) reported "several" on high elevation balds on Alleghany and Lantz mountains, Highland County, in June 1986. Three collections from Shenandoah Mountain in the George Washington National Forest by J. C. Mitchell, C. A. Pague and others on 2 June 1987 were on Bother Knob (USNM 516647-516648), Flagpole Knob (USNM 516635-516638), and Skidmore Ridge (USNM 516640-516646).

Nine *O. vernalis* were among the road-killed snakes examined by JCM on the Blue Ridge Parkway and Skyline Drive during 1979-1990, when 469 snakes were salvaged and preserved by National Park Service rangers and staff (the collection is housed in the Carnegie Museum of Natural History; CMFS 146601, 146066, 122773, 124875, 146102, 146109, 146088, 146091, 146118). The specimens represented the following counties: Augusta, Greene, Madison, and Rockingham. I found two *O. vernalis* during searches in Big Meadows, Shenandoah National Park, on 24 July 1990 and 26 June 1991. S. M. Roble and A. C. Chazal (Virginia Natural Heritage Program, pers. comm.) photographed an *O. vernalis* in Shenandoah National Park on 28 June 2005 on a forested trail leading to Rocky Mountain (38° 17.93' N, 78° 40.40' W, 851 m [2793 ft] ASL), Rockingham County, Virginia). This site is 32 km southwest of Big Meadows.

Most recently, specimens from Frederick County (University of Georgia Museum of Natural History, GMNH 49215) collected in 1996 and Shenandoah County, Virginia (GMNH 49214) collected in 2001, were reported by Akre (2003) and Akre & Robinson (2003). Roberts & Tickle (2004) captured and photographed one on Brushy Mountain, Bland County, in August 2004. First (2005) reported finding two *O. vernalis* in Floyd County in 2003 and 2004 along Goose Creek near Hemlock in the northern part of the county. These records validate the occurrence of this species in the southern Blue Ridge Mountains near Roanoke, based originally on a specimen collected in May 1962 in Roanoke County (USNM 149120).

The creation of the Virginia Herpetological Society in 1958 inaugurated a period of intensive field searching for locality records of all native species of amphibians and reptiles that resulted in the first comprehensive set of distribution maps for the state (Tobey, 1985). However, only 23 locality records of

Smooth Greensnakes were added after 1975 and all but the one in Floyd County (First, 2005) located north of the James River. These collective observations (Fig. 1) imply that viable populations exist in portions of the Blue Ridge Mountains and several locations in the Ridge and Valley Physiographic Province. *Opheodrys vernalis* occurs in unknown but apparently viable population sizes in the northern Blue Ridge, notably at Big Meadows in Shenandoah National Park (Witt, 1993; W. H. Martin, pers. comm.; JCM, pers. obs.).

Two areas south of that drainage that offer suitable habitat for Smooth Greensnakes in southwestern Virginia are Burkes Garden in Tazewell County (near the Bland County record) and Mt. Rogers in the Blue Ridge Mountains, Smyth and Grayson counties. In his extensive travels in these two regions, R. L. Hoffman (pers. comm.) is unaware of any reports of uniform-colored green snakes, nor are the ranger staffs of Grayson Highlands State Park and Mount Rogers National Recreation Area, Jefferson National Forest.

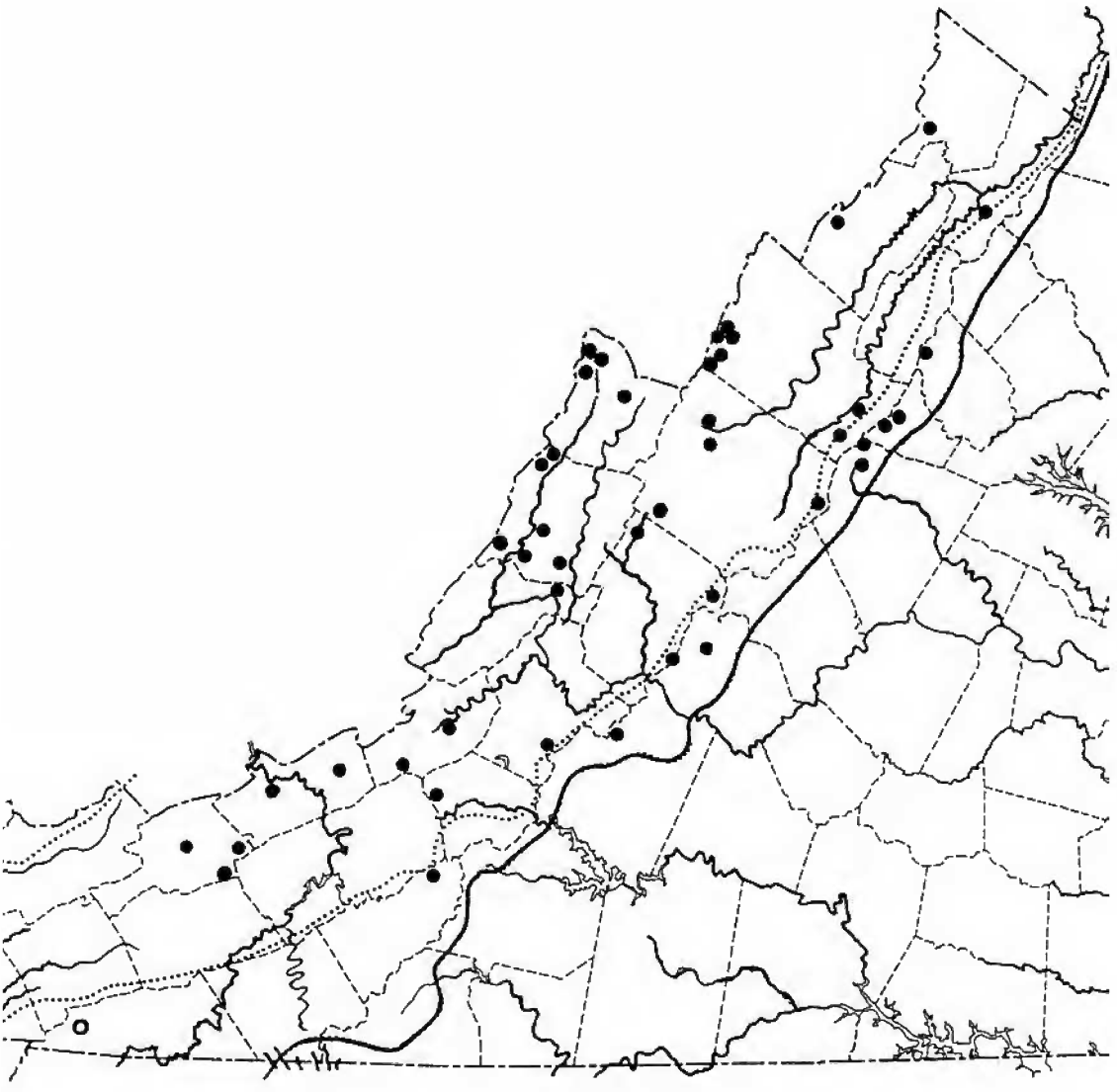

Fig. 1. Map of Virginia illustrating known locations for *Opheodrys vernalis*. The putative record for Washington County is indicated by an open circle. All other localities are shown as solid circles because they are within the known extant range of this species. The dark line to the east of the distribution pattern is the eastern margin of the Blue Ridge Physiographic Province.

OPHEODRYS VERNALIS IN NORTH CAROLINA

The tenuous evidence for the occurrence of *O. vernalis* in North Carolina is reviewed in Palmer & Braswell (1995) in their *O. aestivus* account under Remarks. The earliest (and still only) North Carolina record based on an extant specimen (Museum of Comparative Zoology, Harvard University, MCZ 2287; Palmer & Braswell, 1995) was collected in 1871 on the French Broad River in Madison County (Brimley, 1944). Like many other specimens taken in the late 1800s, the locality data are not absolutely certain, and might be disregarded except for several additional facts. W. H. Weller (1930) reported finding this snake at Chimney Rock, Rutherford County, North Carolina. Weller (1930) noted that *O. vernalis* was rather scarce; he observed only three individuals during 1928-1930. The next species in his checklist is *Opheodrys aestivus*, which reduces the possibility that Weller may have misidentified his snakes. He apparently was able to distinguish both species and must have been familiar with *O. vernalis* in his home state of Ohio. R. L. Hoffman (pers. comm.) personally identified two road-killed *O. vernalis* in 1952 along the Blue Ridge Parkway, both near Mount Mitchell, Yancy County, NC. Palmer & Braswell (1995) do not include a full species account, citing a need for valid museum specimens. Walley (2003) does not include these North Carolina historic records in his review.

There are only four separate historical localities known for this species in western North Carolina. Any one of these alone could probably be discounted (e.g., as escapees from automobiles or pet containers, especially at summer camps). These observations, information in the literature, and the museum record suggest that Smooth Greensnakes were present in parts of the southern Appalachians (although apparently not as far south as the Great Smoky Mountains), but already declining and rare by the middle of the 20th century. That none has been reported in North Carolina since 1952, despite intensive biological collecting throughout the Appalachians, would seem to represent a requiem for *O. vernalis* farther south than the latitude of about Roanoke, Virginia.

OTHER SOUTHERN APPALACHIAN "RECORDS"

A putative *O. vernalis* from a lumberyard in northern Georgia was collected in the mid to late 1980s by a student of Dr. Kenneth Fahey and brought in alive to Brenau College, Gainesville, Georgia. Dennis Herman (pers. comm.) saw the snake before it was preserved. Dr. Fahey (pers. comm.) still has the specimen and will donate it to the North Carolina Museum of Natural Sciences. Fahey dismissed the find as having come in on a shipment of lumber, and noted that several searches of the area revealed no additional specimens (D. Herman, pers. comm.). The validity of the record remains in doubt.

DISCUSSION AND CONCLUSIONS

Lack of observations of *O. vernalis* by R. L. Hoffman (pers. comm.) during the past four decades in western Virginia, the fact that no additional specimens have been taken at the Mountain Lake Biological Station for over five decades (H. Wilbur, University of Virginia, pers. comm.), and the apparent extirpation of this species in North Carolina suggest that populations of this snake may have declined and its range contracted in the southern portion of its range during the past century. That no additional specimens have been reported from North Carolina suggests that the Smooth Greensnake may be extirpated from the southernmost region of the Appalachians. The putative *O. vernalis* from Georgia must be discounted due to lack of information on an extant population. The recent Floyd County, Virginia, report (First, 2005) is the only known locality south of the James River in the Blue Ridge Mountains. The three localities in Bland and Giles counties are the only ones known south of the New River. Whether they represent healthy or declining populations is unknown.

One may invoke the factor of post-Pleistocene climate warming and northward retreat of plants and animals to explain the apparent range contraction of *O. vernalis* in the southern Appalachians. Historical landscape changes caused by humans may have also played a role. Clearing of forests by American Indians and colonists, as well as natural forest dynamics, created open areas colonized by grasses, especially in the mountains. Such habitats are favored by *O. vernalis* in high elevations, as they are currently found in some numbers in mountain balds and sites like Big Meadows in Shenandoah National Park.

The information summarized in this contribution may be interpreted as consistent with an ongoing, progressive decline of a snake species in the extreme southeastern portion of its former range. Searches for this snake should be made in all of the southwestern counties south of the New River to determine its current status in this region. Perhaps there are unreported new county records to be found. Reports of all observations, preferably with a voucher photograph or collections of road-kills and other specimens, should be placed in museums and published in the scientific literature so that future reviews of range contraction in this species can achieve a higher level of accuracy than possible

here. The conservation status of *Opheodrys vernalis* in Virginia should also be reviewed through field verification of all of the above known localities to determine if they still support populations. Such knowledge is the only way to effectively assess the true status of this high elevation snake in Virginia and the southern Appalachian portion of its range.

Conservation efforts on behalf of *O. vernalis* should consist of maintaining high elevation grasslands and control of encroachment by woody vegetation. Prescribed burns should be conducted on a regular basis by George Washington and Jefferson National Forest biologists and fire managers at all known grassland sites over 0.3 ha (1 acre) in size or larger. Prescribed fire has been used effectively in Big Meadows in SNP to maintain the open grassland vegetation (Cocking et al., 1976; Otto et al., 1977). This form of management should continue at this important location. Consideration should be given by National Park Service biologists to the use of mechanical tree removal and prescribed fire in previously known *O. vernalis* locations to enhance population growth and movement among sites in SNP. Private landowners in mountainous regions could contribute to this effort by allowing searches for this snake and by using prescribed fire as a tool to maintain their grassland habitats.

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